Mr. Langley, effect of nicotin on the nervous system of the fresh-water crayfish.

Mr. Shipley, on a new species of Phymosoma, with some account of the geographical distribution of the genus.

Mr. Adami, on the action of the papillary muscles of the heart.

Mr. Harmer, exhibition of specimens of a Land-Planarian (*Rhynchodemus terrestris*, O. F. Müller) found in Cambridge.

SCIENTIFIC SERIALS.

THE *American Meteorological Journal* for March contains the conclusion of M. Faye's articles on the theory of storms, based on Redfield's laws. The author maintains that cyclones are descending whirls with a vertical axis, that they originate in the upper currents of the atmosphere, and follow the course of these currents. He considers it very desirable that two different modes of drawing charts should be adopted, to distinguish between cyclones and statical depressions to which, in his opinion, the laws of storms do not in any way apply.—Prof. H. A. Hazen contributes an article on the spectre of the Brocken, and gives a summary of various explanations of the phenomenon. He gives the results of his observations upon a similar shadow seen upon Mount Washington. This number also contains an extract from a paper by Dr. Schenck on the climatic treatment of pulmonary consumption; the advantages of New Mexico, especially, are pointed out.

In the number of the *Journal* for April, M. Faye commences a series of articles on trombes and tornadoes; he deals principally in this number with the theories of various writers and with descriptions of the phenomenon.—Mr. A. H. Dutton analyses the laws laid down by Padre Viñes relative to the normal points of recurvature of West India hurricanes. The result of his inquiry is that less than 14 per cent. of the tropical storms obeyed the laws.—Mr. A. L. Rotch summarizes the proceedings of the International Hydrological Congress held at Paris in October last. The next Congress is to be held in Rome in 1892.

Department of Agriculture, Bulletin No. 4, July 1889 (by authority, Government Printing Office, Melbourne)—This Report embodies the results of State-aided scientific effort which is intended to benefit agriculture, as we sincerely trust it will. The contents are miscellaneous, although all have direct bearing on the theory and practice of agriculture. Reports on horse-breeding, the needs of plants, irrigation, liquorice, yields of milk, vineyards, fruit-culture, Danish dairying, &c., yield a varied diet for the omnivorous reader, and will be of special service to Australian cultivators. We plead guilty to a feeling in connection with the perusal of such *Bulletins* as this, that the work is official, and lacks spontaneity. There is, notwithstanding, much that is valuable. Take, for example, the raisin industry (p. 91). Here we find described the conditions for successful growth, varieties, cultivation, and drying. What can be more useful to a colonist up country than to possess trustworthy information in detail on such a subject? If he is engaged in the wider pursuits of horse or cattle ranching, he will find subject-matter—addresses of breeders, names of sires, and other information of solid value. The *Bulletin* will also be of interest to the increasing class of owners of land in Australia who reside in England, as well as to young men who are thinking of making Australia their home. Anyone writing for this class of information should secure the previous numbers and also the future issues, and these he would probably be able to obtain free of charge by application at the offices of the Agricultural Department at Melbourne, or in London, at the Australian Colonial Offices in Victoria Street.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 27.—"Measurements of the Amount of Oil necessary in order to check the Motions of Camphor upon Water." By Lord Rayleigh, Sec. R.S.

The motion upon the surface of water of small camphor scrapings, a phenomenon which had puzzled several generations of inquirers, was satisfactorily explained by Van der Mensbrugghe (*Mémoires Couronnés* (4to) of the Belgian Academy, vol. xxxiv., 1869), as due to the diminished surface-tension of water impregnated with that body. In order that the rotations may be lively, it is imperative, as was well shown by Mr. Tomlinson, that the utmost cleanliness be observed. It is a good plan to submit the internal surface of the vessel to a preliminary treatment with strong sulphuric acid. A touch of the finger is usually sufficient to arrest the movements by communicating to the surface of the water a film of grease. When the surface-tension is thus lowered, the differences due to varying degrees of dissolved camphor are no longer sufficient to produce the effect.

It is evident at once that the quantity of grease required is excessively small, so small that under the ordinary conditions of experiment it would seem likely to elude our methods of measurement. In view, however, of the great interest which attaches to the determination of molecular magnitudes, the matter seemed well worthy of investigation; and I have found that by sufficiently increasing the water surface the quantities of grease required may be brought easily within the scope of a sensitive balance.

In the present experiments the only grease tried is olive oil. It is desirable that the material which is to be spread out into so thin a film should be insoluble, involatile, and not readily oxidized, requirements which greatly limit the choice.

Passing over some preliminary trials, I will now describe the procedure by which the density of the oil film necessary for the purpose was determined. The water was contained in a sponge-bath of extra size, and was supplied to a small depth by means of an india-rubber pipe in connection with the tap. The diameter of the circular surface thus obtained was 84 cm. (33″). A short length of fine platinum wire, conveniently shaped, held the oil. After each operation it was cleaned by heating to redness, and counterpoised in the balance. A small quantity of oil was then communicated, and determined by the difference of readings. Two releasements of the beam were tried in each condition of the wire, and the deduced weights of oil appeared usually to be accurate to $\frac{1}{20}$ milligram at least. When all is ready, camphor scrapings are deposited upon the water at two or three places widely removed from one another, and enter at once into vigorous movement. At this stage the oiled extremity of the wire is brought cautiously down so as to touch the water. The oil film advances rapidly across the surface, pushing before it any dust or camphor fragments which it may encounter. The surface of the liquid is then brought into contact with all those parts of the wire upon which oil may be present, so as to ensure the thorough removal of the latter. In two or three cases it was verified by trial that the residual oil was incompetent to stop camphor motions upon a surface including only a few square inches.

The manner in which the results are exhibited will be best explained by giving the details of the calculation for a single case, *e.g.* the second of December 17. Here 0·81 milligram of oil was found to be nearly enough to stop the movements. The volume of oil in cubic centimetres is deduced by dividing 0·00081 by the sp. gr., viz. 0·9. The surface over which this volume of oil is spread is

$$\tfrac{1}{4}\pi \times 84^2 \text{ square centimetres;}$$

so that the thickness of the oil film, calculated as if its density were the same as in more normal states of aggregation, is

$$\frac{0{\cdot}00081}{0{\cdot}9 \times \frac{1}{4}\pi \times 84^2} = \frac{1{\cdot}63}{10^7} \text{ cm.,}$$

or 1·63 micro-millimetres. Other results, obtained as will be seen at considerable intervals of time, are collected in the table.

A Sample of Oil, somewhat decolorized by exposure.

Date.	Weight of oil.	Calculated thickness of film.	Effect upon camphor fragments.
	Mg.		
December 17 ...	0·40	0·81	No distinct effect.
January 11 ...	0·52	1·06	Barely perceptible.
,, 14 ...	0·65	1·32	Not quite enough.
December 20 ..	0·78	1·58	Nearly enough.
January 11 ...	0·78	1·58	Just enough.
December 17 ...	0·81	1·63	Just about enough.
,, 18 ...	0·83	1·68	Nearly enough.
January 22 ...	0·84	1·70	About enough.
December 18 ...	0·95	1·92	Just enough.
,, 17 ...	0·99	2·00	All movements very nearly stopped.
,, 20 ...	1·31	2·65	Fully enough.

A Fresh Sample.

January 28 ...	0·63	1·28	Barely perceptible.
,, 28 ...	1·06	2·14	Just enough.

For convenience of comparison they are arranged, not in order of date, but in order of densities of film.

The sharpest test of the quantity of oil appeared to occur when the motions were nearly, but not quite, stopped. There may be some little uncertainty as to the precise standard indicated by "nearly enough," and it may have varied slightly upon different occasions. But the results are quite distinct, and under the circumstances very accordant. The thickness of oil required to take the life out of the camphor movements lies between one and two millionths of a millimetre, and may be estimated with some precision at 1·6 micro-millimetre. Preliminary results from a water surface of less area are quite in harmony.

For purposes of comparison it will be interesting to note that the thickness of the black parts of soap films was found by Messrs. Reinold and Rücker to be 12 micro-millimetres.

An important question presents itself as to how far these water surfaces may be supposed to have been clean to begin with. I believe that all ordinary water surfaces are sensibly contaminated; but the agreement of the results in the table seems to render it probable that the initial film was not comparable with that purposely contributed. Indeed, the difficulties of the experiments proved to be less than had been expected. Even a twenty-four hours' exposure to the air of the laboratory[1] does not usually render a water surface unfit to exhibit the camphor movements.

The thickness of the oil films here investigated is, of course, much below the range of the forces of cohesion; and thus the tension of the oily surface may be expected to differ from that due to a complete film, and obtained by addition of the tensions of a water-oil surface and of an oil-air surface. The precise determination of the tension of oily surfaces is not an easy matter. A capillary tube is hardly available, as there would be no security that the degree of contamination within the tube was the same as outside. Better results may be obtained from the rise of liquid between two parallel plates. Two such plates of glass, separated at the corners by thin sheet metal, and pressed together near the centre, dipped into the bath. In one experiment of this kind the height of the water when clean was measured by 62. When a small quantity of oil, about sufficient to stop the camphor motions, was communicated to the surface of the water, it spread also over the surface included between the plates, and the height was depressed to 48. Further additions of oil, even in considerable quantity, only depressed the level to 38.

The effect of a small quantity of oleate of soda is much greater. By this agent the height was depressed to 24, which shows that the tension of a surface of soapy water is much less than the combined tensions of a water-oil and of an oil-air surface. According to Quincke, these latter tensions are respectively 2·1 and 3·8, giving by addition, 5·9; that of a water-air surface being 8·3. When soapy water is substituted for clean, the last number certainly falls to less than half its value, and therefore much below 5·9.

April 24.—"On a Pneumatic Analogue of the Wheatstone Bridge." By W. N. Shaw, M.A., Lecturer in Physics in the University of Cambridge. Communicated by Lord Rayleigh, Sec. R.S.

When fluid flows steadily through an orifice in a thin plate, the relation between the rate of flow, V, measured in units of volume of fluid per second, and the head H (the work done on unit mass of the fluid during its passage) may be expressed by the equation:—

$$H = RV^2,$$

where R is a constant depending upon the area of the orifice. If the head be measured in gravitation units, R is equal to $1/2gk^2a^2$, where g is the acceleration of gravity, a the area of the orifice, and k the coefficient of contraction of the vein of fluid, a factor which is independent of the rate of flow.

Measurements made upon the flow of air in order to determine the coefficient of contraction have been hitherto such as may be termed "absolute"; that is to say, the head and the flow have each been separately expressed in absolute measure and the value of R determined by taking the ratio of the head to the square of the flow. This process is exactly analogous to measuring the electrical resistance of a wire by finding the electromotive force between its ends and the current which flows along it.

M. Murgue, in a work on "The Theory and Practice of Centrifugal Ventilating Machines" (translated by A. L. Steavenson), has shown that the internal resistance of a centrifugal fan to the flow of air through it can be calculated from the effects produced on the flow by varying the size of a second orifice through which the air had to pass. This process is evidently parallel to calculating the internal resistance of a battery by finding the effect produced upon the current by varying the external resistance. The further development of the analogy seems to afford a "null" method of comparing resistances to the motion of air, and of verifying the laws of flow, and one which requires only a detector and not an anemometer, and is independent of the constancy of the flow. Whether it could be used practically to test the laws of flow and measure the pneumatic constants for various orifices to a higher degree of accuracy than has hitherto been attained, evidently depends upon the sensitiveness of the arrangement. In order to try this, the author constructed what may be called a pneumatic analogue of the Wheatstone Bridge. It consists of three wooden rectangular boxes, A, B_1, B_2. The ends of B_1 and B_2 abut against the side of A; between B_1 and A is a rectangular opening, a_2, 1 in. × ½ in., in a cardboard diaphragm; between B_2 and A a rectangular opening, a_4, 1 in. × 1 in., in a similar diaphragm. In the side of B_1 at a_1 is an adjustable slit, made by cardboard shutters sliding in cardboard grooves, and at a_3 in the side of B_2, opposite to a_1, is a similar adjustable slit. The tube connecting B_1 and B_2, or "galvanometer" tube, is a straight tube of glass, G, of about 1·1 inch internal diameter. It can be closed at one end by a small trap-door in the interior of the box B_1, which can be opened and shut by a steel wire passing through a cork in the top of B_1. The sensitiveness of the apparatus depends upon the indicator employed. There are many indicators that might be suggested; the one tried and found to work well consists of two very small parallel magnetized sewing needles, stuck through a cap of elder-pith, supported on a small agate compass centre; the needles carry very light mica vanes on one side of the centre, counterpoised by a small quantity of platinum wire. The whole is balanced on the point of the finest needle obtainable, and forms a very delicate wind vane. The needles take up a definite position of equilibrium with the planes of the vanes approximately north and south. The apparatus being so placed that the tube, G, is east and west, the vanes always set across the tube when there is no current. The needle-points enable the position of equilibrium to be clearly identified by the aid of a fiducial mark on the glass tube. The sensitiveness can be altered as desired by an external control magnet, just as that of a galvanometer needle can be. The little compass needle or wind vane, M, is very sensitive to the motion of air in the tube.

The head is produced by a gas-burner in a metal chimney fitted to the lid of the box A.

Of the four apertures of the bridge, two, viz. a_2 and a_4, are inaccessible without pulling the arrangement to pieces; they represent areas of ½ sq. in. and 1 sq. in. respectively, as accurately as a knife can cut them in cardboard.

The other two areas, viz. a_1 and a_3, are made by sliding shutters, as already mentioned. The edges were cut with a knife, and they probably are only rough approximations to areas in a truly thin plate.

If the coefficient of contraction may be assumed to be independent of the shape of the orifice, we get the condition for no flow through the "galvanometer" tube:—

$$\frac{a_1}{a_2} = \frac{a_3}{a_4},$$

where the a's represent the actual measured areas of the four orifices.

Observations have been taken with the apparatus—

(1) To verify the law of proportionality of areas, viz.

$$\frac{a_1}{a_2} = \frac{a_3}{a_4}.$$

(2) To verify the inference that the condition of no flow is independent of the total head.

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[1] In the country.

(3) To compare a circular with a rectangular aperture.

The observations are sufficient to show that the width of the adjustable slit when there is no flow is a perfectly definite magnitude, and that a properly constructed apparatus is capable of making measurements of the effective areas of orifices with a very considerable degree of precision.

"On the Effect of Tension upon Magnetic Changes of Length in Wires of Iron, Nickel, and Cobalt." By Shelford Bidwell, M.A., F.R.S.

The *iron* used in these experiments was a piece of soft annealed wire, 0·7 mm. in diameter and 10 cm. in length between the clamps. The weights successively attached to it were equivalent to 1950, 1600, 1170, 819, 585, and 351 kilos. per square cm. of section.

The *nickel* wire was 100 mm. long, and 0·65 mm. in diameter. The loads under which it was examined were 2310, 1890, 1400, 980, 700, and 420 kilos. per sq. cm.

The *cobalt* used was a narrow strip measuring 100 mm. by 2·6 mm. by 0·7 mm., its cross section being, therefore, 1·82 sq. mm. It was not possible to obtain this metal in the form of a wire. The loads employed for the strip were equivalent to 772, 344, and 75 kilos. per sq. cm.

In all the experiments the loads were successively applied in decreasing order of magnitude, and before every single observation the wire or strip was demagnetized by reversals, without, of course, being removed from the coil. The magnetizing force was carried up to about 375 C.G.S. units for iron and nickel, and 500 units for cobalt.

The results are given in several tables and curves, and point to the following conclusions:—

Iron.—Tension diminishes the magnetic elongation of iron, and causes contraction to take place with a smaller magnetizing force.

Nickel.—In weak fields the magnetic contraction of nickel is diminished by tension. In fields of more than 140 or 150 units, the magnetic contraction is increased by tensional stress up to a certain critical value, depending upon the strength of the field, and diminished by greater tension.

Cobalt.—The magnetic contraction of cobalt is (for magnetic fields up to 500 G.C.S. units and loads up to 772 kilos. per sq. cm.) practically unaffected by tension.

Chemical Society, April 3.—Dr. Hugo Müller, F.R.S., Vice-President, in the chair.—The following papers were read:—Note on the hydrosulphides, by Messrs. S. E. Linder and H. Picton. The authors find that freshly-precipitated metallic sulphides almost always contain hydrogen sulphide, that they are, in fact, hydrosulphides or remnants of hydrosulphides, and that if, instead of adopting the usual plan of passing gas through the solution, the metallic salt be allowed to run slowly into a solution of hydrogen sulphide in water in the absence of too large an excess of acid, a solution of the hydrosulphide is obtained which can be freed from dissolved hydrogen sulphide by the current of hydrogen. The copper hydrosulphide, $7CuS, H_2S$, and mercury hydrosulphide, $31HgS, H_2S$, are described in the paper.—Researches on the germination of some of the *Gramineæ*, Part I., by H. T. Brown, F.R.S., and Dr. G. H. Morris. This investigation was undertaken with the view of throwing some light on the complex metabolic processes which take place in the germination of seeds. The authors, during the progress of the inquiry, have examined and experimented with the seeds of a great number of the grasses, but this, the first part of their paper, is confined almost entirely to a consideration of the changes which take place in barley during the earlier periods of its growth. In recording the visible changes which occur in the seed during germination, it is shown that a disintegration and dissolution of the cell-walls of the endosperm always precede any attack upon the cell-contents. This breaking down of the cell-wall is shown in a subsequent portion of the paper to depend on the production during germination of a special cellulose-dissolving or "cyto-hydrolytic" enzyme, which, like diastase, is soluble. The action of this enzyme on the cell-walls of some kinds of vegetable parenchyma is very energetic. The physiological importance of this cyto-hydrolyst is very great, for, owing to the non-diffusible nature of the amylo-hydrolytic enzyme—diastase—the previous breaking down of the cell-wall is a necessary prelude to the dissolution of the contained starch-granules. The authors show that the appearance of the cyto- and amylo-hydrolysts is due to a specialized secretory function of the layer of columnar epithelium which covers the outer surface of the scutellum. It has hitherto been considered that the function of this epithelium was exclusively that of an absorptive tissue: its absorptive as compared with its secretory functions are, however, of quite secondary importance. The natural food material—starch—does not appear to have any special power of stimulating the cells of the epithelium to increased secretion of a diastase, but the flow both of diastase and of the cyto-hydrolytic enzyme from these cells is affected in a very remarkable degree by the presence of certain carbohydrates. Providing the carbohydrate is one which is readily assimilable by the embryo, such as cane-sugar or maltose, secretion of ferment is checked or even entirely inhibited. No such inhibitory action is, however, produced by such substances as mannitol and milk-sugar, which are entirely without nutritive value. The authors' experiments in this direction point to the secretion of the amylo-hydrolytic and cyto-hydrolytic enzymes as being to some extent *starvation phenomena.* The power of secretion possessed by the epithelium is in some way or other so adapted to the requirements of the young plant as to be only exercised when the supply of tissue-forming carbon compounds begins to fail. The histological changes which take place in the cells of the epithelium during secretion are very similar to those which have been observed in certain secretory cells of the alimentary tract of animals, and in the secretory cells of some of the insectivorous plants. The authors confirm the important generalization of Sachs, that the relation of the embryo to the endosperm is that of parasite to host, and they have availed themselves of this relation by cultivating the embryo on suitable media after separating it from its endosperm. In this way they have obtained information with regard to the secretory powers of the embryo and the chemical modifications of its absorbed nutriment which it would have been impossible to obtain by any other means. The results of cultivating excised embryos on various nutrient solutions, more especially of the carbohydrates, are recorded, and it is shown that, whilst cane-sugar, invert-sugar, dextrose, lævulose, maltose, raffinose, galactose, and glycerol have all more or less nutrient value, milk-sugar and mannitol do not in any way contribute to the growth of tissue in the young plant. Of all the substances tried, cane-sugar has by far the greatest nutritive power. Maltose, although the natural food of the embryo when attached to its endosperm, is decidedly inferior in this respect to cane-sugar. This, at a later point in the paper, is shown to be due to the fact that maltose, directly it is absorbed by the growing embryo, becomes transformed into cane-sugar by the living cells, and in this form is passed from cell to cell. When cane-sugar is supplied ready formed to the young plantlet, there is manifestly a saving of energy to the living cell, which receives its nutriment in a form in which it is readily available for its requirements. An examination of the sugars produced during germination, and their mode of distribution in the grain, have convinced the authors that the transformed starch of the endosperm is absorbed by the embryo in the form of maltose, and that the seat of production of the cane-sugar which all germinated grain contains is the tissues of the embryo itself. The authors are continuing their work upon the germination of the grasses, and are applying the methods described in this first part of their paper to an elucidation of the chemical changes which the other reserve materials, especially the proteids, undergo in their passage from the endosperm, and of the agencies which are at work in bringing about these transformations. In the discussion which followed the reading of this paper, Prof. Marshall Ward, F.R.S., pointed out that in the seeds of the *Gramineæ*, *Cyperaceæ*, and other families of plants, there is a peculiar layer of cells, from one to three or more deep, surrounding the starchy endosperm, and distinguished from the latter by containing no starch, but relatively large quantities of proteids: this layer belongs to the endosperm, but as the seed ripens, the cells store special proteids instead of the starch-grains which predominate in other endosperm cells. In the oat there is such a layer, one cell deep, and it has been shown that, during germination, the dissolution of the starch and the cell-walls of the starch-containing cells begins near the surface of this layer, which itself persists, and the cells of which take up food and undergo changes so like those of excreting cells that it was concluded that they excrete the diastatic enzyme. Prof. Ward further remarked that the authors' suggestion that more than one enzyme may be excreted according to the nutrition of the cells, and their proof that a cellulose-dissolving enzyme exists in barley, are borne out by various recent researches, and by Wortmann's observations on the behaviour of bacteria in a mixture of starch and proteids. Wortmann proved that so long as the bacteria were fed with proteids they refused to excrete the diastatic enzyme which they produce in abundance when only carbohydrates are at their disposal. Prof. Green said that in the case of the date-stone his observations led him to believe that the enzyme was independent of the endosperm, and that probably it was located in the epithelial layer. But in castor oil seeds not only the embryo but also the endosperm cells appeared to be possessed of vitality, the fatty matter of the latter undergoing change even when not subject to the action of the embryo; probably the enzyme was present in the form of an enzymogen, as extracts of the seeds were rendered active by acids. Prof. Armstrong remarked that the authors had shown that in the plant maltose was converted into cane-sugar; dextrose, according to their observations, did not undergo conversion into cane-sugar, but gave invert-sugar—that is to say, it became partially converted into lævulose, these constituents of cane-sugar being apparently incapable of interacting. It was known from Emil Fischer's work that dextrose could be converted into lævulose, and that maltose was an etheric compound of the acetal type, formed from two molecules of dextrose, one of which acted as aldehyde, the other as alcohol; it was conceivable that if the "dextrose residue" in maltose underwent a change comparable with that which is involved in the conversion of dextrose into lævulose, a compound would be obtained which if not identical with cane-sugar would be convertible into it by hydration and subsequent dehydration. The authors had spoken of the maltose becoming incorporated with the protoplasm from which the cane-sugar was then elaborated; perhaps the effect was comparable with that exercised by phenylhydrazine in effecting the conversion of dextrose into lævulose through the agency of the osazone. Dr. Lauder Brunton and Mr. Thiselton Dyer also took part in the discussion.—The formation of indene-derivatives from dibrom-α-naphthol, by Prof. R. Meldola, F.R.S., and Mr. F. Hughes.—The action of hydrochloric acid on manganese dioxide; manganese tetrachloride, by Mr. H. M. Vernon. Contrary to the statements of Pickering (Chem. Soc. Trans., 1879, 654), the author finds that the original product of the action of hydrochloric acid on manganese dioxide is manganese tetrachloride, and that at first no free chlorine is formed.

April 17.—Dr. W. J. Russell, F.R.S., President, in the chair.—The following papers were read:—Phosphorous oxide, Part 1, by Prof. T. E. Thorpe, F.R.S., and Mr. A. E. Tutton. The authors describe a method of making phosphorous oxide by burning phosphorus in air. Pure phosphorous oxide crystallizes in thin monoclinic prisms, melts at 22°·5, solidifies at 21°, and boils unchanged in an atmosphere of nitrogen or carbon dioxide at 173°. When heated at 300°, it decomposes, and at 440° is wholly converted into phosphorus and phosphorus tetroxide: $4P_4O_6 = 6P_2O_4 + P_4$. Phosphorous oxide is readily acted on by light, and in bright sunshine its colour rapidly becomes yellow, and eventually dark red, the violet rays being most active in effecting the change. Its molecular weight, as determined by Hofmann's and Raoult's methods, corresponds with the formula P_4O_6; phosphorous oxide, therefore, in this respect is analogous to arsenious and antimonious oxides. The thermal expansion of liquid phosphorous oxide is expressed by the formula—

$$V = 1 + 0{\cdot}0_3 91377\,t - 0{\cdot}0_6 11175\,t^2 + 0{\cdot}0_8 38607\,t^3;$$

its relative density at the boiling-point is 1·6859, whence its molecular volume = 130·5; and its molecular refraction for A ($\lambda = 7604$) at 27°·4 is 60·5. Contrary to the usual statement of the text-books, cold water has very little action on phosphorous oxide: many days elapse before even a small quantity is dissolved; it then forms phosphorous acid. Hot water acts upon it with explosive violence, forming the red sub-oxide, phosphoric acid, and spontaneously inflammable phosphoretted hydrogen. Phosphorous oxide spontaneously oxidizes to phosphorus pentoxide on exposure to air or to oxygen, and the process of oxidation is attended under diminished pressure by a faint luminous glow; ozone is not formed as the oxidation proceeds. On gently warming the oxide in oxygen, the glow gradually increases in intensity until it passes into flame. In contact with ozone, phosphorous oxide glows at the ordinary temperature and pressure. Phosphorous oxide has a well-marked physiological effect, and it is not improbable that the action hitherto attributed to phosphorus, especially as regards its influence on the glycogenic functions of the liver and on tissue change, may be really due to this substance. The fumes from phosphorus consist largely of phosphorous oxide, and the odour of the product obtained by drawing air over phosphorus without allowing it to ignite is identical with that of the pure oxide; it is, indeed, highly probable, as Schönbein long ago surmised, that phosphorus vapour, as such, is odourless, and that the smell which phosphorus ordinarily possesses is a mixture of that of ozone and of phosphorous oxide.—The action of chlorine on water in the light, and the action of light on certain chlorine acids, by Prof. A. Pedler. As a general result of a number of experiments, it is found that, even in very strong tropical sunlight, water and chlorine interact to but a very slight extent when the proportion is about 100 $H_2O : Cl_2$; when the ratio is about 150 $H_2O : Cl_2$ action takes place to the extent of perhaps 50 per cent., and when more than 400 $H_2O : Cl_2$, to about 80 per cent. of the theoretical. Chlorine water containing about 708 $H_2O : Cl_2$ when exposed to direct tropical sunlight decomposes practically entirely in the sense of the equation $2H_2O + 2Cl_2 = O_2 + 4HCl$, an exceedingly small amount of chloric acid being formed; but when exposed in a south aspect to strong diffused daylight, gives much less oxygen and a variable amount of hypochlorous or chloric acids, very little oxygen but an increased amount of hypochlorous or chloric acids being formed when it is exposed in a north aspect to moderate diffused daylight. Hypochlorous acid, on exposure to light in dilute solutions, yields both oxygen and chloric acid, the proportion of oxygen being larger, the greater the intensity of the light. Solutions of chloric acid undergo little or no change. The author concludes that the action of chlorine on water is in its first stage similar to that which it exercises on cold, dilute aqueous potash or soda, and in its second stage to that on more concentrated hot solutions of these alkalis.—Note on the explosion of hydrogen sulphide and of carbon bisulphide with air and oxygen, by the same. The author finds that when a mixture of hydrogen sulphide, air, and oxygen is exploded, a normal result is obtained, sulphur dioxide and water being formed. But when carbon bisulphide vapour is similarly treated, a not inconsiderable proportion of the nitrogen of the air becomes oxidized, and sulphuric compounds are formed under the combined influence of the oxides of nitrogen and sulphur and of the moisture present.—The action of light on phosphorus, and on some of the properties of amorphous phosphorus, by the same. The author brings forward evidence to show that the term "amorphous phosphorus" is a distinct misnomer, and that, so far from the commercial amorphous phosphorus constituting a separate allotropic modification of the element, it is in reality the same substance as the form called rhombohedral or metallic phosphorus; the very slight differences in character noticed between the substances in question being explained by the difference in the state of division and the slight variations conditioned by their mode of formation. The change of red into ordinary phosphorus does not take place below 358°; above this the change takes place *in vacuo*, but exceedingly slowly, even at 445°.—The action of phosphoric anhydride on fatty acids, by Dr. F. S. Kipping. Heptylic acid yields 25–33 per cent. of dihexyl ketone when heated with phosphoric anhydride.

Royal Microscopical Society, April 16.—Dr. C. T. Hudson, F.R.S., President, in the chair.—Mr. J. Mayall, Jun., called attention to a spiral ruling on glass, sent by Mr. P. Braham, of Bath, which had been produced in an ordinary lathe, the diamond point being adjusted on the slide rest; also to a series of photomicrographs of diatoms, sent by Mr. T. Comber. These were of special interest from the fact that they were produced with sunlight, by which the maximum resolving power of the objective was obtained.—Mr. Mayall referred to an improved form of fine-adjustment, constructed and exhibited by Messrs. Powell and Lealand, in which the chief aim had been to construct a fine-adjustment which should combine extreme sensitiveness of action with accuracy and probable durability beyond what had previously been obtained. The essential feature was the application of what watchmakers would term a "jewelled movement." The whole of the contact surfaces by which the fine-adjustment was actuated consisted of polished steel and agate, the intention being to reduce the friction as much as was consistent with steadiness of motion. The result attained was undoubtedly an improvement on the old system, though the cost would probably limit the application to the few instruments required for very special and difficult investigations in microscopy. For high-class photomicrographic work, or where preparations had to be retained under observation for long periods of time, the new mechanism should be particularly useful, for the greater solidity of the general construction clearly pointed to greater precision and increased stability.—Mr. Goodwin exhibited a form of eye-piece for the microscope which gave a large field with considerable magnifying power.—Mr. A. W. Bennett gave a *résumé* of a paper, by Mr. W. West, on the fresh-water Algæ of North Wales. The paper described a collection of fresh-water Algæ, chiefly diatoms and desmids, made in various localities in North Wales and Anglesey, and it furnished what was beyond comparison the richest list of desmids which had ever been prepared in this country.—Prof. M. M. Hartog's paper, on the state in which water exists in live protoplasm, was read.—A paper descriptive of the method adopted by Mr. Halford in mounting the spermatozoa of the Salmonidæ was read, and specimens in illustration were exhibited by the lantern.—Mr. E. M. Nelson exhibited on the screen several slides showing under high powers (× 1350) the bordered pits of *Pinus* and *Tilia*. He also exhibited a small series of slides to show the qualities of a new apochromatic $\frac{1}{4}$-in. objective with fluorite lenses and of 95 N.A., which had recently been made by Messrs. Powell and Lealand.—Mr. Mayall mentioned that the gathering which was to have taken place at Antwerp, in celebration of the 300th anniversary of the invention of the microscope, was unavoidably postponed until next year.

Paris.

Academy of Sciences, April 28.—M. Hermite, President, in the chair.—On a class of differential equations of which the general integral is uniform, by M. Emile Picard.—On the characteristic equation of nitrogen, by M. Sarrau. In previous communications the author pointed out that certain experiments with carbonic acid verified an equation analogous to those proposed by Van der Waals and Clausius to represent the relation between the pressure, p, the volume, v, and absolute temperature, T. The following is the equation—

$$p = \frac{RT}{v - \alpha} - \frac{K\epsilon^{-T}}{(v - \beta)^2};$$

where R, α, β, K, and ϵ are constants. A discussion of the experiments made by Regnault and by Amagat on nitrogen shows that its critical point may also be represented by this formula.—On the heats of formation and combustion of several nitrogenous bodies derived from albumenoid matters, by MM. Berthelot and André. The bodies experimented upon are glycollamine or glycocoll, alanine, leucine, tyrosine, asparagine, aspartic acid, and hippuric acid.—Researches on the condensation of benzine and acetylene vapour under the action of the silent discharge, by M. P. Schutzenberger. The benzine condenses into a clear, yellow, resinous solid. Analyses of the liquid employed and of the condensed product are given, and it is shown that the amount of oxygen contained in the latter could not have been taken up from the air, but must have passed through the glass tube.—On *Gomphostrobus heterophylla*, a coniferous prototype from the Permian of Lodève, by M. A. F. Marion.—Observation of Brooks's comet (α 1890) made with the Brunner equatorial at Toulouse Observatory, by M. E. Cosserat.—General theory of the visibility of interference fringes, by MM. J. Macé de Lépinay and Ch. Fabry. The consequences which follow from the theorem demonstrated are pointed out, and it is proposed to describe the experiments which verify them in a future communication.—On the phosphites and the pyrophosphite of lead, note by M. L. Amat.—The action of erythrite upon the alkaline alcoholates, by M. de Forcrand. The author gives a continuation of a previous paper, here discussing formulæ for the bodies discovered and giving thermal data which explain the behaviour of the new substances when heated.—The action of lead oxide upon toluene and the production of benzene, by M. C. Vincent. The paper treats of this reaction at temperatures below the melting-point of lead. The conclusions are drawn: (1) that oxide of lead attacks toluene below 335°, giving water, carbonic anhydride, and benzene; (2) that, at higher temperatures, less benzene and more stilbene and higher hydrocarbons are obtained; (3) that at a red heat, in addition to the above, hydrocarbons produced by the simple heat decomposition of benzene and toluene are obtained; (4) that diphenyl formed during this experiment in small quantity comes rather from the benzene formed by the action of oxide of lead upon the toluene than from benzene contained in the toluene employed.—Thermochemical researches on textile fibres (wool and cotton), by M. Léo Vignon.—Experiments relative to the loss and gain of nitrogen by fallow or cultivated land, by M. A. Pagnoul. The writer finds in the cases examined that the gain of nitrogen in two years is—(1) with bare soil 29 kg. per hectare; (2) with grass land 394 kg. per hectare; (3) with land laid down in clover 904 kg. per hectare.—Note by M. Ant. Magnin, on the parasitic castration of *Anemone ranunculoides* by *Æcidium leucospermum*.—On the discovery of a giant land tortoise at Mont Léberon, by M. Ch. Depéret.—On the action of the positive pole of a constant galvanic current upon microbes, and particularly upon the anthrax bacillus, by MM. Apostoli and Laquerrière. Among the conclusions drawn are the following: the heating effects of the current may be experimentally neutralized, but the destruction or weakening of vitality of the microbe still takes place; it is the positive pole only which acts upon the microbes, the negative pole and the intermediate space do not give any evidence of adverse action upon the organisms; the current *sui generis* has no effect upon the microbes; the action at the positive pole is due to the disengagement of acids and of oxygen, as will be shown in a further note.—On the existence of tuberculous endocarditis, note by M. Raymond Tripier.

Berlin.

Meteorological Society, April 1.—Prof. Schwalbe, President, in the chair.—Dr. Perlewitz spoke on the influence of the city of Berlin on local climatic conditions. To investigate this he had compared, for the year 1889, the meteorological records of two stations outside the city with those of three inside. As regards temperature, some allowance must be made for the fact that the exposure of the thermometers was not identical at all the stations. The differences in temperature between the city and the surrounding country were greater than for Vienna, the maximal difference showing itself in spring and summer, the minimal in winter. The differences were least at 2 p.m., greater at 7 a.m., and greatest at 9 p.m. The absolute humidity was much less inside the city than in the neighbouring country, and the difference was, as regards maxima and minima, the exact reverse of that which held good for the temperature; whereas, on the other hand, the relative humidity followed the same lines as for differences of temperature. The direction of the wind was generally different in the city from that in the surrounding country, but no definite relationship of the two could be deduced from the observations, and the same held good for the frequency and extent of clouds in the two localities. Thunderstorms were observed less frequently in the city than in the country, but here again it must be borne in mind that the conditions under which observations can be made in the former are much less favourable than for the latter.—Prof. Spörer spoke on the rotation of the sun, and came to the conclusion that the continued endeavours which have been made to determine the rotation of the sun from observations of sun-spots, cannot lead to any definite conclusions.

Physical Society, April 18.—Prof. du Bois-Reymond, President, in the chair.—Prof. Planck spoke on the difference of potential of two binary electrolytes. According to recent views there exists, in any uniform dilute solution of an electrolyte, a complete dissociation of the ions, the latter being in equilibrium, since the sum of the two electricities of the anions and kathions is equal and the osmotic pressure is everywhere the same, quite independently of the nature of the ions. The electrical charge of the ions and the osmotic pressure are the sole forces which are at work in the solution, and suffice to account for all the phenomena which take place inside it. But in order to calculate the above it is necessary to know the mobility of the ions; this has been determined experimentally by Kohlrausch for a large number of different ions, and he has also measured the electrical charge of the ions, this charge being independent of their nature. If the solution is not of uniform composition, the osmotic pressure leads to a movement of the ions from the more to the less concentrated parts of the solution. Now, since the mobility of the ions varies, being five times as great for hydrogen as for chlorine, it follows that a larger number of hydrogen atoms will pass from the more concentrated parts of the solution, than of chlorine. This, however, leads to an upsetting of the electrical equilibrium, and the electrical affinities work in a direction opposite to that of the flow of atoms. The speaker had developed a general mathematical formula to express what takes place in the case of two solutions of different concentrations which are in contact with each other through an intervening porous partition. By means of this formula he has calculated the magnitude of the differences of potential which establishes itself between the two electrolytes. Applying the formula to a special case, and calculating the difference of potential from the observed rate of flow of the ions and their known electrical charge, he showed that the values thus obtained correspond very closely with those obtained by direct measurement of the difference of potential.

Physiological Society, April 25.—Prof. du Bois-Reymond, President, in the chair.—Dr. Heymans spoke on medullated and non-medullated nerves. The medullary sheath of the former is characterized by the myelin formations which it yields under the action of water and the dark coloration with osmic acid. This last reaction is common to lecithin, protagon, and cholesterin, all of which are found in the medulla. When, however, lecithin has been treated with osmic acid it can no longer be extracted from the nerve, whereas protagon and cholesterin may be extracted by alcohol at 70° C. By taking advantage of this difference in their behaviour it becomes possible to test the statement that lecithin occurs in the neurokeratinous network of the medullary sheath, while protagon and cholesterin are present in the meshes of the network. Experiment does not support the above statement. The speaker had further used the reaction with osmic acid (2 per cent. solution) to investigate the occurrence of non-medullated nerves in certain places in which their presence is a subject of dispute. He found them in the sympathetic and olfactory nerves of the pike, but in much smaller numbers in the former than is usually stated to be the case. In many of the sympathetic fibres he observed a sheath composed of protoplasm which stained brown with osmic acid. He finally discussed fully the transition of medullated cerebrospinal nerves into the non-medullated processes of the ganglia.—Dr. Cowl spoke on methods of recording the variations of blood-pressure in an artery. He criticized the various forms of apparatus in use, and pointed out the errors arising from the use of elastic connections so frequently employed, as a result of which it is impossible to register the exact moment at which the pressure is zero. He had constructed an apparatus in which this source of error is avoided, and which admits of extremely delicate adjustment. He finally exhibited curves to demonstrate the advantages of the newer instrument.

BRUSSELS.

Academy of Sciences, March 1, 1890.—The following were the papers communicated:—Experiments made by Count Espiennes at Scy (Ciney), on the circulation of air during calm nights from the surface of broken ground, by M. F. Folie.—On certain inversions of temperature, and on the frost of September 16, 1887, at Spa, by M. G. Dewalque. In this and the preceding paper it is shown that cold strata of air lie in valleys, and many cases are given of places situated on elevated plateaus where the minimum temperature is habitually higher than that at places of less altitude lying in valleys.—Gustavus Adolphus Hirn, Associate of the Academy, born at Logelbach (Colmar), August 21, 1815, died at the same place, January 14, 1890. An account of his life and work is given by M. F. Folie.—Another obituary notice by M. F. Folie, on C. H. Buys-Ballot, born at Kloetingen, October 10, 1817, died at Utrecht, February 3, 1890.—On phillipsite crystals from sediments found in the centre of the Pacific Ocean, by M. A. F. Renard. In a previous note (February 1890) the physical characteristics and the composition of zeolite crystals from deposits in the Pacific were indicated; the author now shows the conditions under which the phillipsite and mineral matters which accompany it are found.—Determination of the variations in the coefficient and diffusion with temperature for liquids other than water, by M. P. De Heen. The liquids investigated are xylene, benzine, ethyl alcohol, amyl alcohol, amyl benzoate, and carbon bisulphide, at temperatures of 10°, 30°, 50°, 70°, and 90°.—On the nature of the polarizing matter of the beetroot in alcohol; rotatory power of pectous matters, by MM. L. Chevron and A. Droische. It is found pectine and its derivatives exercise an energetic action on polarized light; the rotatory power of these matters is three or four times greater than that of saccharose sugar.—Some properties of conics, by M. C. Servais.—On the centre of curvature of lines described during the displacement of a plane figure in its own plane, by the same author.—Solanidine from potato sprouts; preparation and properties, by M. A. Jorissen.—On semi-invariant functions, by Jacques Deruyts.

AMSTERDAM.

Royal Academy of Sciences, April 25.—Prof. van de Sande Bakhuysen in the chair.—M. T. Forster read a paper on the influence of smoking on tuberculous matter. He had formerly shown that tuberculous matter does not cease to be infectious after salting. Experiments subsequently made in his laboratory prove that salting *and* smoking do not kill the bacteria of tuberculosis. Not only tuberculous matter, but meat from tuberculous cattle is very infectious.—Prof. van de Sande Bakhuysen communicated an abstract of a paper published by him on an instrument for the determination of the absolute personal error in astronomical transit-observations.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Light, Heat, and Sound: C. H. Draper (Blackie).—Leçons sur l'Electricité, tome i.: E. Gerard (Paris, Gauthier-Villars).—A Hand-book of Descriptive and Practical Astronomy, vol. 2, 4th edition: G. F. Chambers (Oxford, Clarendon Press).—Official Year-Book of the Scientific and Learned Societies of Great Britain and Ireland (Griffin).)—Electrical Influence Machines: J. Gray (Whittaker).—Electric Transmission of Energy, 2nd edition: G. Kapp (Whittaker).—Zoologische Ergebnisse einer reise in Niederländisch Ost-Indien, Erstes Heft: Dr. Max Weber (Leiden, Brill).—Memoirs of the Geological Survey of India—Palæontologia Indica; ser. xiii., Salt Range Fossils; vol. iv. Part 1, Geological Results: W. Waagen (Trübner).—The Criminal: H. Ellis (W. Scott).—Notes on the Pearl and Chank Fisheries and Marine Fauna of the Gulf of Manaar: E. Thurston (Madras).—Food Adulterations: A. J. Wedderburn (Washington).—The Beginnings of American Nationality: A. W. Small (Baltimore).—Journal of the Royal Statistical Society, March (Stanford).—Traité Encyc. de Photographie, 15 April (Paris, Gauthier-Villars).—Journal of the Anthropological Institute, vol. xix. No. 3 (Trübner).—Brain, Part 49 (Macmillan).—Mass. Institute of Technology, Boston, Annual Cat., 1889-90 (Camb., Mass.).—Journal of the Royal Microscopical Society, April (Williams and Norgate).—Bulletin of the American Geological Society, vol. 21, Supplement 89, vol. 22, No. 1 (New York).—Missouri Agricultural College Experiment Station Bulletin, Nos. 6 and 9 (Columbia, Miss.).

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